

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

To:

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Date of mailing
(day/month/year)

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Applicant's or agent's file reference

P00195PCT

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/SE 2004/001701

International filing date (day/month/year)

19.11.2004

Priority date (day/month/year)

20.11.2003

International Patent Classification (IPC) or both national classification and IPC

H01L 21/027, G02B 26/00, G03F 7/20

Applicant

Micronic Laser Systems AB, IPR & Legal Department et al

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☒ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later. 20/9

3. For further details, see notes to Form PCT/ISA/220.

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Form PCT/ISA/237 (cover sheet) (January 2004)

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Box No. I

Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
☐ This opinion has been established on the basis of a translation from the original language into the following language, _____, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material
☐ a sequence listing
☐ table(s) related to the sequence listing
 - b. format of material
☐ in written format
☐ in computer readable form
 - c. time of filing/furnishing
☐ contained in the international application as filed.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

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Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application

☒ claims Nos. 2, 25

because:

☐ the said international application, or the said claims Nos. _____
relate to the following subject matter which does not require an international preliminary examination (*specify*):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 2, 25
are so unclear that no meaningful opinion could be formed (*specify*):

Claims 2 and 25 are considered to be statements of desiderata as they lack all technical features necessary for achieving the alleged non-uniformity.

☐ The claims, or said claims Nos. _____ are so inadequately supported
by the description that no meaningful opinion could be formed.

☐ no international search report has been established for said claims Nos. _____

☐ the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:

the written form ☐ has not been furnished

☐ does not comply with the standard

the computer readable form ☐ has not been furnished

☐ does not comply with the standard

☐ the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in the Annex C-bis of the Administrative Instructions.

☐ See Supplemental Box for further details.

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Box No. IV Lack of unity of invention

1. ☐ In response to the invitation (Form PCT/IPEA/206) to pay additional fees the applicant has:
- ☐ paid additional fees
 - ☐ paid additional fees under protest
 - ☐ Not paid additional fees
2. ☒ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
- ☐ Complied with
 - ☒ Not Complied with for the following reasons:

A priori, the separate inventions are:

Invention I: Claims 1-4 are directed to a method for patterning a work piece.

The solution of invention I is to determine the uniformity as a function of the number of exposure flashes.

Invention II: Claims 5-9 are directed to a method for printing a work piece.

The solution of invention II is to change a parameter of the exposure flashes per surface element on a layer-by-layer basis. The changed parameter is for example the number of flashes, the pulse length or the radiation bandwidth.

Invention III: Claims 10-17 are directed to a number of alternative procedures in a scanner or stepper. Some parts of claims 10-17 have special technical features linked with claims 1, 2-4, for example the changing of the parameters pulse length, number of flashes or laser bandwidth.

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4. Consequently, this opinion has been established in respect of the following parts of the international application:

- ☒ all parts
- ☐ the parts relating to claims Nos. _____

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: BOX IV.

1(2)

The solution of invention III is to provide a scanner system with an optical field larger than 10 mm and to increase one or more parameters to obtain a non-uniformity from speckle amounts less than 0.5%.

Invention IV: Claims 18-22 are directed to a procedure in a maskless scanner.

The solution of invention IV is to provide an optical field larger than 0.5 mm and to increase parameters, for example the laser bandwidth or the pulse length, in a maskless scanner system to obtain a speckle amount less than 0.5% and to provide a maskless scanner with an optical field larger than 0.5 mm.

Invention V: Claims 23 and 26 are directed to an apparatus for printing a work piece.

The solution of invention V is to calculate the speckle and to change the number of pulses per surface element.

Invention VI: Claim 24 is directed to a procedure for optimizing the speckle during microlithographic printing. The solution of invention VI is to provide a model for the value of the improved CD uniformity, for the cost of printing with a particular number of pulses, to provide logic and resources to select a number of flashes and to provide a control adapted to change the number of flashes.

All of these inventions alternate the number of flashes. However, there is no other technical relationship among the inventions involving a corresponding special technical feature (PCT Rule 13.2).

The search concerns the first invention mentioned but also includes all six inventions, I-VI.

From for instance US 4970546, an illumination control device which uses a minimum number of pulses required for substantially smoothing a speckle pattern is known. The invention as defined in the independent claims 1 and 4

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2 (2)

differs from this technique in that the uniformity is determined for a plurality of layers. To use the arrangement from US 4970546, considered as the closest prior art, on several layers in a patterning process instead of on one layer is considered to be obvious for a person skilled in the art. Therefore, the technique mentioned in the independent claims 1 and 4 lacks an inventive step. Since the invention according to claims 1 and 4 lacks an inventive step, the remaining claims, 2 and 3, will consist of two separate inventions.

A posteriori, the separate inventions are:

Invention I:1: Claims 1-2 relate to a method for patterning a work piece with improved CD uniformity by selecting a combination of values of the radiation bandwidth, pulse length or radiation flash frequency so that a calculated illumination non-uniformity from speckle amounts to less than 0.5%.

Invention I:2: Claim 3 relates to a method for patterning a work piece with improved CD uniformity by determining a value of a slit width so that a calculated illumination non-uniformity from speckle amounts to less than 0.5%.

These inventions are not so linked a posteriori as to form one single general inventive concept (PCT Rule 13.1). There is no technical relationship among the inventions involving a corresponding special technical feature (PCT Rule 13.2).

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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>1, 3-24 and 26</u>	YES
	Claims	_____	NO
Inventive step (IS)	Claims	_____	YES
	Claims	<u>1, 3-24 and 26</u>	NO
Industrial applicability (IA)	Claims	<u>1, 3-24 and 26</u>	YES
	Claims	_____	NO

2. Citations and explanations:

The application refers to a method and an apparatus to pattern a work piece where the improved CD uniformity is a function of the number of exposure flashes from the partially coherent electromagnetic radiation source.

Reference is made to the following documents:

D1: US 4970546 A1
D2: JP 2135723, abstracts of Japan
D3: JP 3179357, abstracts of Japan
D4: US 4822975 A1

Document D1 concerns an illumination control device which uses a minimum number of pulses required for substantially smoothing a speckle pattern. See for example the abstract, column 2, lines 47-52 or column 3, lines 1-10.

Document D2 is related to an exposure controlling device controlling the quantity of exposure and adjusting the quantity of light. See abstract.

Document D3 describes an exposure controller which optimizes the quantity of exposure and uniformizes the illuminance. See abstract.

Document D4 concerns a method and apparatus for scanning exposure with a pulsed laser beam. It describes a relationship between the number of pulses and the distance between two positions in the scan direction corresponding to the intensity level portions. See especially the abstract and column 4, lines 3-36.

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Continuation of: BOX V.

1 (2)

The method and apparatus for patterning a work piece by determining the uniformity as a function of the number of flashes described in document D1 are considered as representing the most relevant prior art. The invention as defined in the independent claims 1 and 4 differs from this technique in that the uniformity is determined for a plurality of layers and that cost of patterning is determined. To use the arrangement from D1 on several layers in a patterning process instead of on one layer is considered to be obvious for a person skilled in the art. The technical effect of determining the cost is considered to be equivalent to optimizing the number of flashes, which is a common goal for a person skilled in the art. To minimize the number of pulses is also known from document D1. Therefore, what is mentioned in claims 1 and 4 lacks an inventive step.

The method mentioned in claim 3 comprising the action of determining a value of the slit width is considered as the common way of optimizing uniformity on a patterned work piece. It is also mentioned in documents D2-D4 how to minimize the number of exposure pulses. Therefore, what is mentioned in claim 3 is considered to lack an inventive step.

The invention as defined in the independent claims 5-8 and 18 differs from the technique described in D1 in that the uniformity is improved by changing different parameters, such as the number of exposure flashes or the radiation bandwidth. A person skilled in the art facing the problem of affecting the printing on a work piece knows from what is described in D2-D4 to, for example, adjust the quantity of light. If the person skilled in the art modifies the closest prior art with the technique described in D2-D4, he will reach the invention as defined in claims 5-8 and 18.

Therefore, the technique described in claims 5-8 and 18 does not involve an inventive step.

The method mentioned in claim 9 comprising the action of performing the change for a critical layer in the microelectronic device only is considered to be obvious for a person skilled in the art. Therefore, what is mentioned in claim 9 is considered to lack an inventive step.

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2 (2)

The procedure mentioned in claims 19-22 relating to obtain different amounts of speckle is considered to be alternative ways of increasing the parameters mentioned in claim 18. This is considered to be obvious for a person skilled in the art and, therefore, what is mentioned in claims 19-22 is considered to lack an inventive step.

The invention as defined in the independent claim 10 differs from the technique described in D1 in that the uniformity is improved by increasing different parameters, such as the number of exposure flashes or the radiation bandwidth. A person skilled in the art facing the problem of affecting the printing on a work piece knows from what is described in D2-D4 to, for example, adjust the quantity of light. If the person skilled in the art modifies the closest prior art with the technique described in D2-D4, he will reach the invention as defined in claim 10. Therefore, the technique described in claim 10 does not involve an inventive step.

The procedures mentioned in claims 11-17 relating to increase some of the parameters mentioned in claim 10, obtaining a certain speckle or to use different types of optic elements is considered to be alternative ways of change parameters or details obvious for a person skilled in the art. Therefore, what is mentioned in claims 11-17 is considered to lack an inventive step.

The invention as defined in the claims 23, 24 and 26 differs from the technique described in D1 in that it optimizes and calculates a speckle during microlithographic printing.

Making a model is an obvious thing to do when optimizing. To use the arrangement from D1 on several layers in a patterning process instead of on one layer is considered to be obvious for a person skilled in the art. The technical effect of determining the cost is considered to be equivalent to optimizing the number of flashes, which is a common goal for a person skilled in the art. To minimize the number of pulses is also known from document D1. Therefore, what is mentioned in claims 23, 24 and 26 lacks an inventive step.

The invention is industrially applicable.